16SI-MSMA-EL-01-00006

January
Sem - I
(2025)

Seat No. ______

MASTER OF SCIENCE MATHEMATICS Examination

· MSC MATHS Semester - 1 JANUARY 2025 (Regular) JANUARY - 2025

CLASSICAL MECHANICS-1

Faculty Code : 003

Subject Code : 16SI-MSMA-EL-01-00006

Time : 2:30 Hours] [Total Marks : 70

Instructions: All questions are compulsary

Q.1 Answer Briefly any seven of the following (Out of ten) 14

1 1. Define: Torque or moment of force.

2. Define with example: Constraints.

3. Define with example: Scleronomous constraints.

4. Find the degrees of freedom for dumbbell and simple pendulum.

5. State: Principle of virtual work and D'Alembert's principle.

6. Define: Generalized co-ordinates.

7. If the potential energy of a linear harmonic oscillator is $V = \frac{1}{2}kx^2$. Then find the equation of motion using Hamilton's variational principle.

8 8. State only the Kepeler's first law of planetary motion.

9 9. State only the Angular momentum conservation theorem for a single particle.

10 10. State minimum two differences between rheonomous constraints and scleronomous constraints.

Q.2 Answer the following (Any Two) 14

1. State and prove, angular momentum conservation theorem for a system of particles.

2. Discuss in detail conservation of energy for a system of particles.

3. Explain in detail principle of virtual work and derive the D'Alembert's principle.

Q.3 Answer the following 14

a) Derive the Lagrange's equations of motion using Hamilton's variational principle.

2 b) Find the equation of motion for a single particle in space in (1) Cartesian co-ordinates (2) Plane polar co-ordinates.

OR

Answer the following 14

1 a) Find the equation of motion for a bead sliding on a uniformly rotated wire.

2 b) Define cyclic co-ordinate. Prove that, the generalized momentum conjugate to a cyclic co-ordinate is conserved. Using this result deduce that, if component of total applied torque vanishes then the corresponding component of L along n is conserved.

Q.4 Answer the following questions (Any Two) 14

a) Show that, the shortest distance between two points in a plane is a straight line.

b) A particle falls a distance y_0 in a time $t_0 = \sqrt{\frac{2y_0}{g}}$, if the distance y at any time t is $y = at + bt^2$ then show that, the integral $\int_0^{t_0} L\, dt$ has an extremum for real values of the co-efficients only when $a = 0$ and $b = \frac{g}{2}$

Q.5 Answer the following (Any Two) 14

A hoop rolling without slipping from an inclined plane then find the force of friction acting on the hoop.

Show that, the central force motion of two bodies about their centre of mass can always be reduced to an equivalent one body problem.

Derive the orthogonal matrix of transformation in 2- dimensional co-ordinate system.

Derive the matrix of orthogonal transformation in terms of Cayley – Klein parameters.